Turbine Section

Report of Test No. RT-169549

General Electric Company
Schenectady, N.Y.

TITLE	Tests on a 50,000 KVA Hydraulic Turbine Driven Generator for Wolf Creek Dam Customer's Unit 5 Serial No. 6638288
REFERENCE	Department of the Army, Corps of Engineers Specification Serial No. ENG-40-058-49-9 General Electric Company Requisition A-96247-1
TESTS MADE AND REPORT PREPARED BY	N. W. Perry, Large Motor & Generator Engineering, General Electric Company, Schenectady, N. Y.

I hereby certify that this Report of Test No. RT-169549 is a true record taken from field tests on generator No. 6638288.

Signed ____________

Sworn to and subscribed before me this 11th day of October 1952.

____________ Notary Public

CHARLES P. LANE
Notary Public, State of New York
Schenectady Co. Reg. No. 337
Commission expires: Mar. 30, 1954

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SUMMARY OF TESTS

Resistances at 25°C, Unit 5

Serial No.	6638288
Armature, line-neutral	.0127
Field	.1463

Short Circuit Ratio, 1.210

Losses and Efficiency

Percent Load		1.15	100	75	50	25
Friction and Windage		186	186	186	186	186
Core Loss		367	367	367	367	367
Stray Load Loss		231	163	90	50	22
Armature I^2R		263	199	111.8	50.2	12.4
Field I^2R	1.0 PF	112	98.5	78.1	64.3	49.4
	0.9 PF	194	164	122.3	91.2	67.8
Total Losses	1.0 PF	1159	1013.5	832.9	717.5	636.8
	0.9 PF	1241	1079	877.1	744.4	655.2
Efficiency, Test	1.0 PF	98.02	98.01	97.82	97.21	95.15
	0.9 PF	97.66	97.66	97.46	96.79	94.50
Efficiency, Guaranteed	1.0 PF	97.55	97.55	97.35	96.80	94.35
	0.9 PF	97.20	97.20	97.00	96.40	93.75

Telephone Interference Factor, Balanced:

Phase A - B	9.65
B - C	9.69
C - A	9.69

Maximum Wave Form Deviation Factor

100% volts 1.1%

Reactances

Negative Sequence Reactance	34%
Zero Sequence Reactance	17.7%
Direct Axis Subtransient Reactance	31.4%
Quadrature Axis Subtransient Reactance	38.8%

INTRODUCTION

This report records tests made from May 6 to May 24, 1952 on the hydraulic turbine driven generators rated 68 poles, 50,000 KVA, 105.9 RPM, 13800 volts, 60 cycles, 0.9 power factor. Each generator is furnished with a direct connected main exciter rated 10 poles, 290 KW, 250 volts and a direct connected pilot exciter rated 6 poles, 12 KW, 250 volts.

The General Electric Company serial numbers on the units in this power station are:

	Generator	Main Exciter	Pilot Exciter
Unit #1	6638292	2439697	2439698
Unit #2	6638291	2439695	2439696
Unit #3	6638290	2439693	2439694
Unit #4	6638289	2439691	2439692
Unit #5	6638288	2439689	2439690
Unit #6	6638287	2439687	2439688

The generators are driven by Francis type hydraulic turbines manufactured by the Baldwin Lima Hamilton Corporation and controlled by governors manufactured by the Woodward Governor Company.

PROCEDURE OF TEST

The A.I.E.E. Publication "Test Code for Synchronous Machines", June 1945 was used as the standard under which the tests were conducted.

At the request of Mr. F. H. Wolf and Mr. Harris of the customer's Nashville, Tennessee office, the overspeed test, three phase short circuit test, residual telephone interference factor, and resistances of other units were waived.

Owing to the extremely strong demand for power in this region and the need for maintenance of continuity of service, it was deemed by the Corps of Engineers to be wholly impractical to uncouple the turbine and generator in order to ascertain generator friction and windage. Friction and windage was, therefore, estimated by assigning to the generator a test value in the ratio of the calculated value of the generator friction and windage to the total calculated friction and windage. The calculated friction and windage of the turbine was supplied by the turbine manufacturer.

Instrument errors were not considered in the generator tests. In making a-c measurements, all three phases were measured at the same time and an average value used.

Carbon copies of the original test data were given to the Corps of Engineers at Wolf Creek Dam. Copies of instrument and instrument transformer calibration values were given to the same personnel.

DIELECTRIC TESTS OF ARMATURE AND FIELD WINDINGS

These tests were made by the General Electric Company erection supervisor prior to releasing the machines for commercial operation. Each generator armature winding was given 28600 volts RMS for one minute and each field winding was given 5000 volts for one minute.

RESISTANCE MEASUREMENT OF ARMATURE AND FIELD WINDINGS

All resistance measurements were made with a General Electric portable double bridge. The temperature of the windings was determined by mercury thermometers attached to the coils. The values were corrected to a base of 25°C and are tabulated in the Summary, Page 1.

NO LOAD SATURATION

Generator unit 5 was driven by its turbine at rated speed with the neutral grounded and the armature leads open-circuited. Readings of field current, armature voltage and speed were recorded for various values of field current increased in successive steps. All points were taken on the ascending part of the curve. Curve of the test results is on page 4.

SHORT CIRCUIT SATURATION

Generator Unit 5 was driven by its turbine at rated speed with the neutral grounded and with its terminals short circuited. Readings of field current, armature current and speed were recorded for various values of field current increased in successive steps. Curve of the test results is on page 4.

SHORT CIRCUIT RATIO

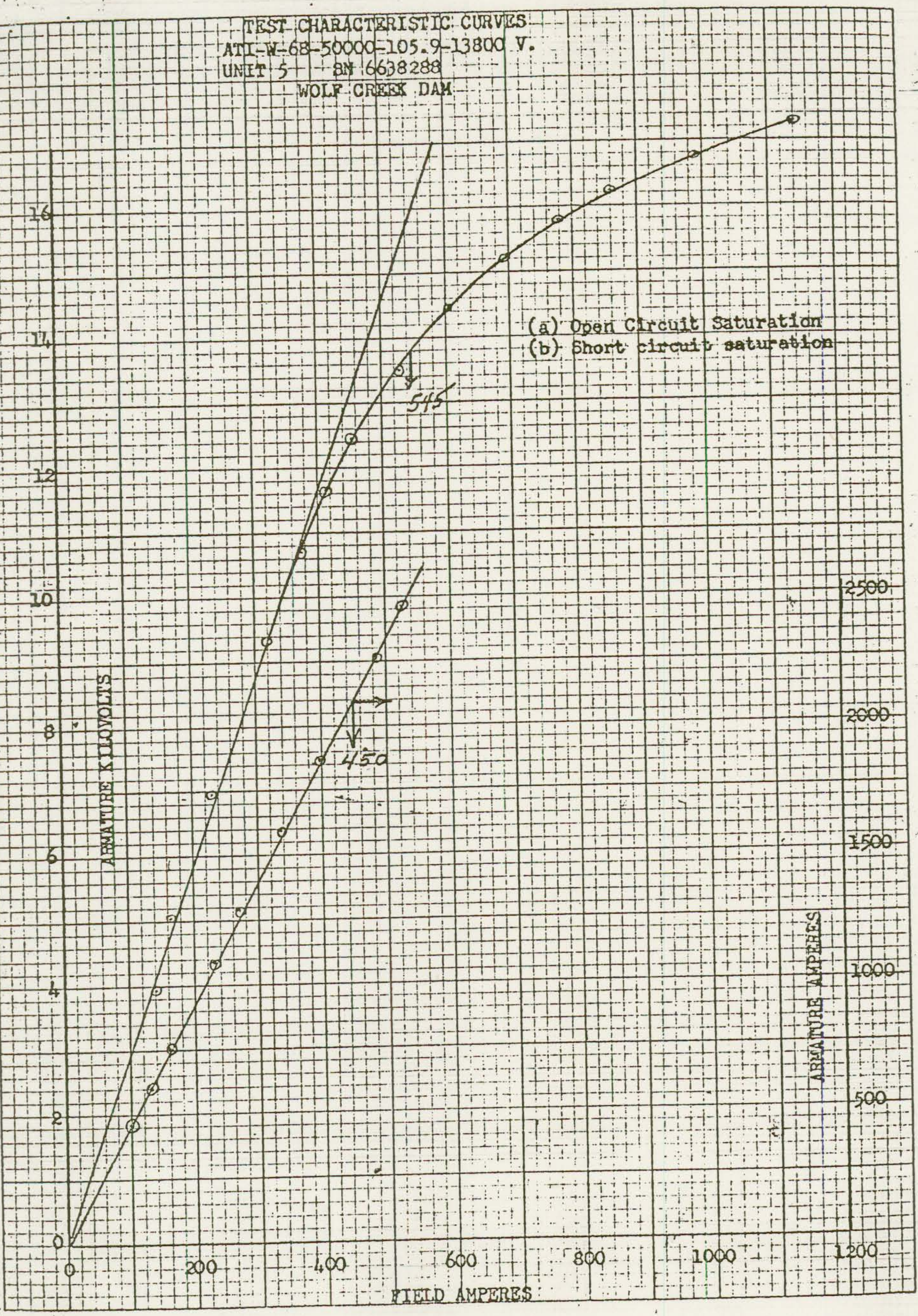
The short circuit ratio is defined as the field current necessary to produce normal no load voltage divided by the field current necessary to produce normal rated current on a 3 phase short circuit. From the saturation and synchronous impedance curves on page 4, the short circuit ratio is as follows:

$$SCR = \frac{545}{450} = 1.210$$

HEAT RUN

The specifications require that a heat run be made at rated voltage, current and power factor. Since the system voltage could not be reduced, the heat run was made at existing system voltage. The generator under test had been carrying rated load for several hours with an increased flow of cooling water so that the cooling air temperature was approximately 22°C. The heat run was continued with this increased cooling water for three and one-half hours at the value of load shown below. Data were recorded every half hour until temperature leveled.

Line volts	14,750
Line Amperes	1,960
Output KVA	50,000
Output KW	45,648
Power Factor	0.911
Field Current	1,066
Field Voltage	174



TEST CHARACTERISTIC CURVES
ATI-W-68-50000-105.9-13800 V.
UNIT 5 SN 6638288
WOLF CREEK DAM
(a) Open Circuit Saturation
(b) Short circuit saturation
545
450
ARMATURE KILOVOLTS
ARMATURE AMPERES
FIELD AMPERES
0
2
4
6
8
10
12
14
16
0
200
400
600
800
1000
1200
500
1000
1500
2000
2500

Air Out of Coolers °C	21.9
Air Out of Generator °C	41.7
Station Ambient °C	24
Temperature Rise °C over Air out of Coolers	
Stator Coils by RTD	39.1
Stator Coil End Turn by Thermocouple	17.6
Field Coil by V/A	32.6
Stator Core by Thermocouple	29.1
Actual Temperature °C	
Thrust Bearing by RTD	64
Thrust Bearing by Thermometer	64
Thrust Bearing Oil by RTD	35
Thrust Bearing Oil by Thermometer	35
Lower Guide Bearing by RTD	44
Lower Guide Bearing by Thermometer	41
Upper Guide Bearing by RTD	53
Upper Guide Bearing by Thermometer	49
Water Temperature °C	
Water Supply	9
Thrust Bearing Return	13
Air Cooler Return	16

The cooling water supply to the air coolers was reduced so that the air leaving the air coolers would be approximately 40°C. Operation of the generator at the same load was continued for another 5 hours until temperature leveled. Results of this heat run are below.

Line Volts	14,730
Line Amperes	1,988
Output KVA	50,600
Output KW	45,950
Power Factor	0.9075
Field Current	1,068
Field voltage	187
Air out of Cooler, °C	39.5
Air out of Generator, °C	61.9
Station Ambient, °C	26.5
Temperature Rise °C over air out of coolers	
Stator coils by RTD	40.5
Stator coil end turn by thermocouple	21.6
Field coil by V/A	37
Field coil by Thermometer (Shutdown)	34.5
Stator core by thermocouple	32.3
Stator core by thermometer (Shutdown)	31.5
Field Coil Connection by thermometer (Shutdown)	23.5
Actual Temperature, °C	
Thrust Bearing by RTD	65
Thrust Bearing by thermometer	65
Thrust Bearing oil by RTD	36

Thrust Bearing oil by thermometer	37
Lower guide bearing by RTD	44
Lower guide bearing by thermometer	42
Upper guide bearing by RTD	57
Upper guide bearing by thermometer	53
Water Temperature, °C	
Water supply	9
Thrust bearing return	13
Air cooler return	32

CONVENTIONAL EFFICIENCY TEST

This test includes the determination of I^2R losses in the armature and field windings, friction and windage loss, open circuit core loss and short circuit core loss or stray load loss. The exciter friction and windage is included as a part of the generator losses, but other exciter and rheostat losses are not included in the determinations of generator efficiency.

FRICTION & WINDAGE LOSS
OPEN CIRCUIT CORE LOSS
SHORT CIRCUIT CORE LOSS

Since the determination of these losses is closely related, they will be discussed together.

The turbine of unit 5 was coupled but unwatered by draining the penstock and closing the draft tube gates and pumping the water out of the draft tube to a level below the turbine runner.

Generator No. 6 was used as the driving unit and generator No. 5 as the driven generator under test. The exciters on generator No. 4 supplied the field excitation as required for generators 5 and 6.

With both units Nos. 5 and 6 at standstill, the armatures were connected together and approximately 80% of no load field current was applied to each generator. Generator No. 6 was started by its turbine and brought up to speed, generator No. 5 coming up in synchronism with it. The exciters of units Nos. 5 and 6 were not energized during this starting period or during any of the deceleration runs.

For the friction and windage runs the field current of both generators was adjusted to approximately 80% of no load rated voltage field current and the speed of the units was increased to about 120 RPM. The field current was reduced to zero and a trial deceleration run for friction and windage was then made by taking periodic readings of speed and time. The speed of unit 6 was kept approximately 5 RPM below the speed of unit 5. At the conclusion of a run, field was applied to both units, and after the generators had pulled into step, the speed was increased to approximately 120 RPM and the sequence repeated. With a constant bearing temperature and friction, three friction and windage runs were made. The results are plotted on page 8 as runs Nos. 1, 2, & 3.

For the open circuit core loss, the operating procedure was the same as above, except that various values of field current were held on the test machine during the deceleration runs Nos. 4, 5, 8 & 14. An additional friction and windage run No. 9 was made. For results, see pages 9 and 8.

The short circuit core loss or stray load loss runs were made in a similar manner except that after the armatures of the units had been electrically separated, the field was removed from unit 5 and a short circuit applied by means of a set of disconnects and air circuit breakers. The field on unit 5 was increased to a decided value for the deceleration run. Immediately after each run the stator resistance temperature detectors were read. Short circuit core loss data is plotted as runs Nos. 10, 11, 12 & 13. See page 10.

CALCULATION OF LOSSES FROM DECELERATION CURVES

Paragraph 1.397, page 20 of the "A.I.E.E. Test Code for Synchronous Machines", dated June 1945, contains the following expression for loss as related to the inertia and rate of deceleration of a rotating body:

$$KW = 0.9244 \times 10^{-6} \times \frac{WK^2 \times N_M \times A}{T_2 - T_1}$$

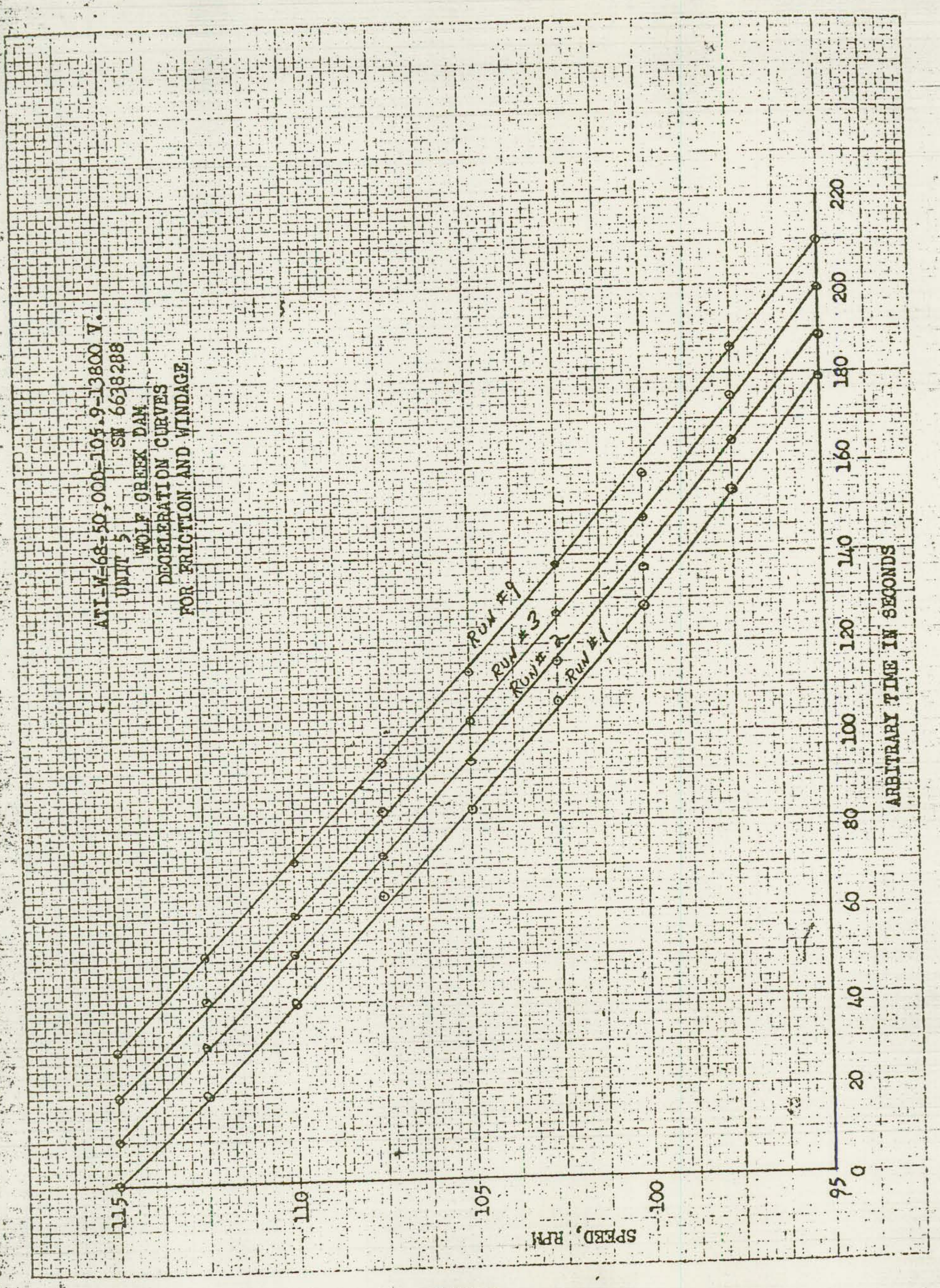
where KW = loss of rotating body in kilowatts
W = weight of the rotating body in lbs.
k = radius of gyration in feet
N_M = speed at which loss is to be determined
A = some arbitrary increment of speed
T_1 = time in seconds when speed is $N_M + A$
T_2 = time in seconds when speed is $N_M - A$

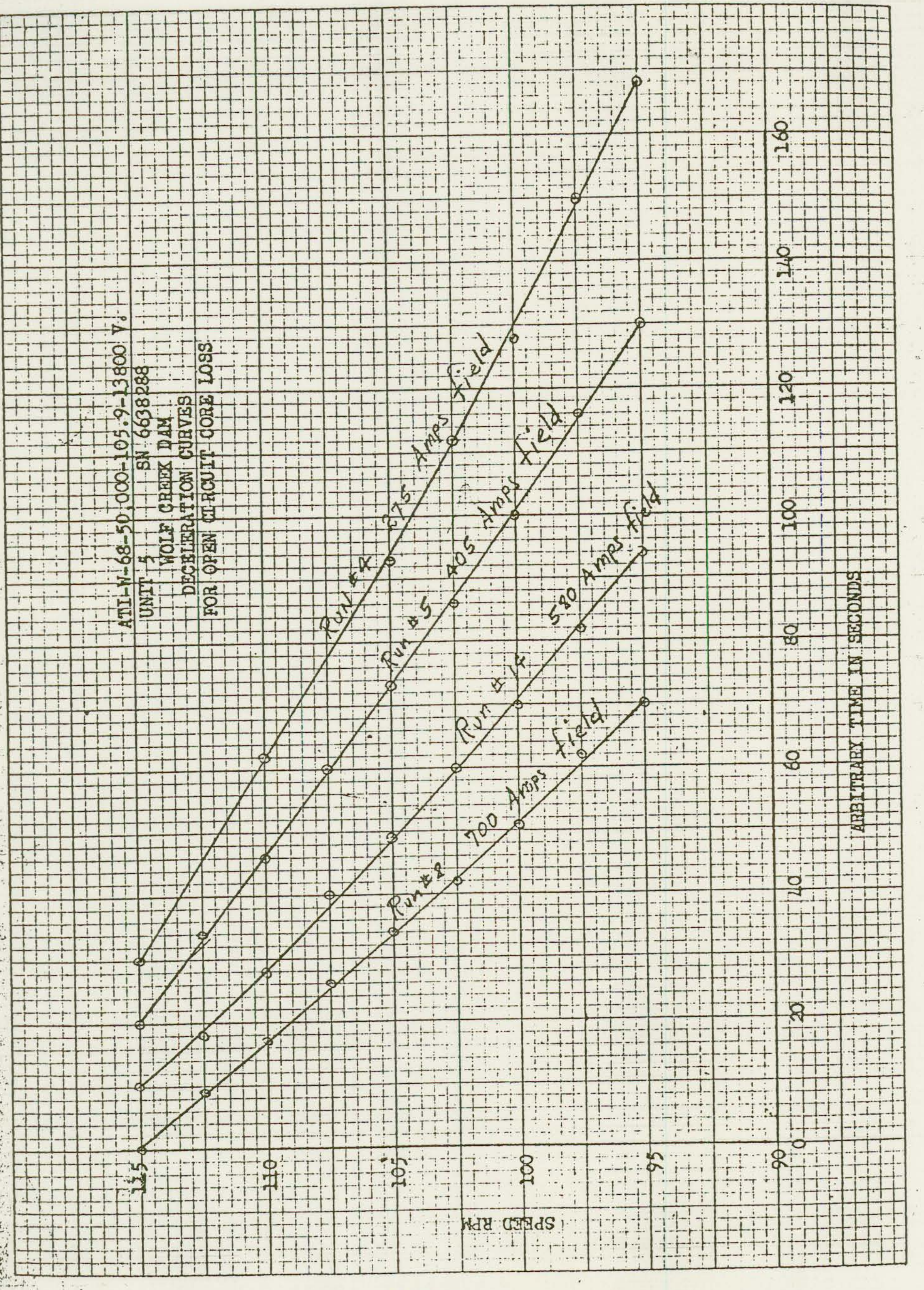
For these units the following values were used:

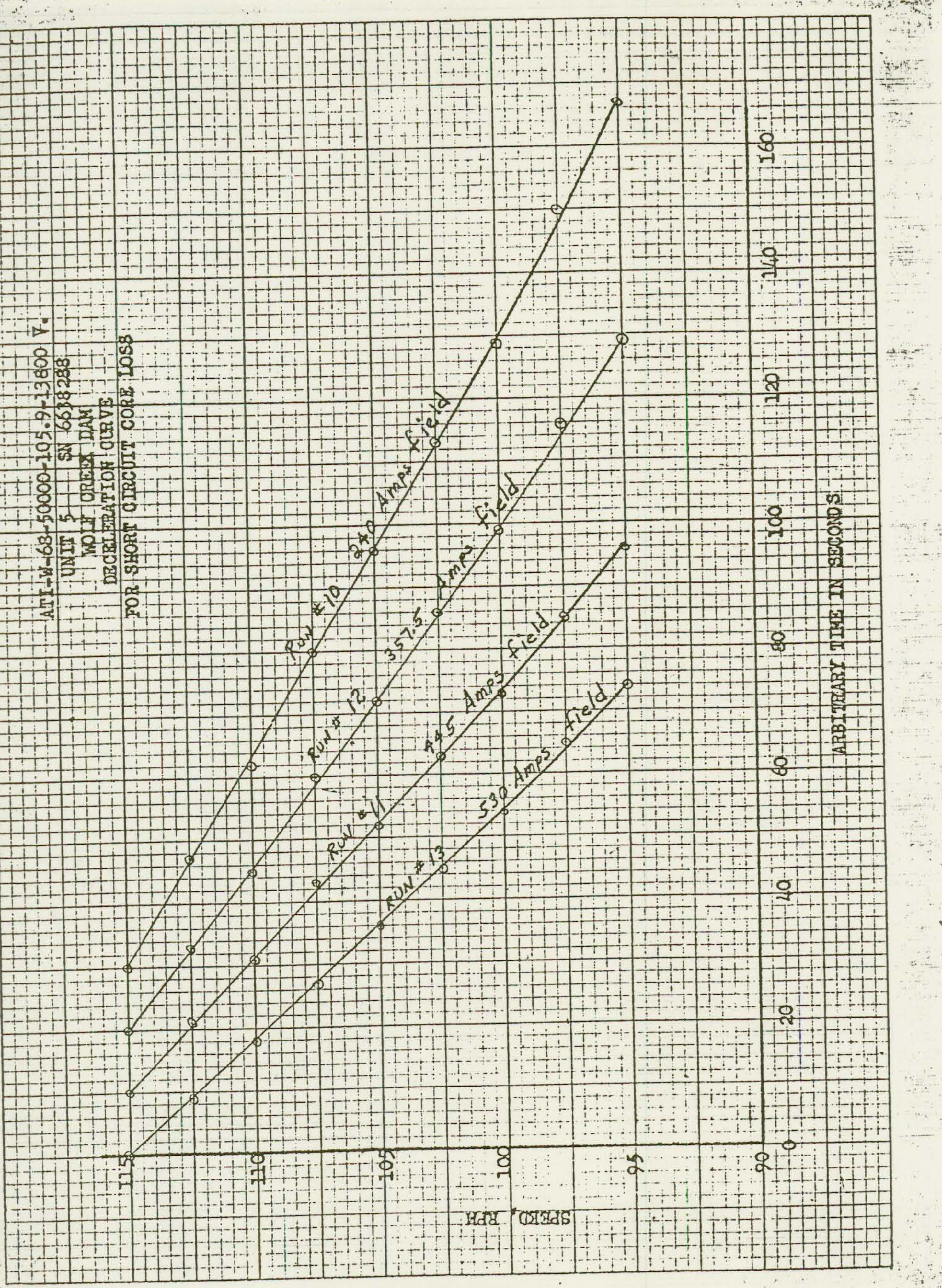
WK^2 = 58,000,000 (calculated Generator)
WK^2 = 3,300,000 (calculated Turbine)
Total WK^2 = 61,300,000
N_M = 105.9 RPM
A = 5 RPM

Substituting these values in the expression for loss, we obtain

$$KW = \frac{30,000}{T_2 - T_1}$$


ATI-W-68-50,000-105.9-13800 V.
UNIT 5, SN 6638288
WOLF CREEK DAM
DECELERATION CURVES
FOR FRICTION AND WINDAGE
RUN #9
RUN #3
RUN #2
RUN #1
SPEED, RPM
115
110
105
100
95
ARBITRARY TIME IN SECONDS
0
20
40
60
80
100
120
140
160
180
200
220


ATI-W-68-50,000-105.9-13800 V.
UNIT 5 SN 6638288
WOLF CREEK DAM
DECELERATION CURVES
FOR OPEN CIRCUIT CORE LOSS
Run #4 275 Amps field
Run #5 405 Amps field
Run #14 580 Amps field
Run #8 700 Amps field
SPEED RPM
115
110
105
100
95
90
ARBITRARY TIME IN SECONDS
0
20
40
60
80
100
120
140
160



ATI-W-68-50000-105.9-13800 V.
UNIT 5 SN 6638288
WOLF CREEK DAM
DECELERATION CURVE
FOR SHORT CIRCUIT CORE LOSS
Run # 10 240 Amps field
RUN # 12 357.5 Amps field
RUN # 11 445 Amps field
RUN # 13 530 Amps field
SPEED, RPM
115
110
105
100
95
90
ARBITRARY TIME IN SECONDS
0
20
40
60
80
100
120
140
160

For the loss runs described above we may now form the following tables:

FRICTION AND WINDAGE
TABLE 1

Run No.	$T_2 - T_1$	KW
1	87	345
2	88	341
3	88	341
9	88	341

Average F & W = 342 KW

OPEN CIRCUIT CORE LOSS
TABLE 2

Run No.	$T_2 - T_1$	KW	KW - (F&W)	LINE VOLTS
4	67	448	106	8,010
5	53.5	560	218	11,400
8	34	882	540	15,100
14	41.8	717	375	13,900

SHORT CIRCUIT CORE LOSS
TABLE 3

Run	$T_2 - T_1$	(1) KW	2 I^2R_s	(1) - (2) - (F&W)	LINE AMPS
10	66	455	56.5	56.5	1163
11	42	715	197.5	175.5	2164
12	53	565	120.7	102.3	1691
13	36	833	251.	240	2435

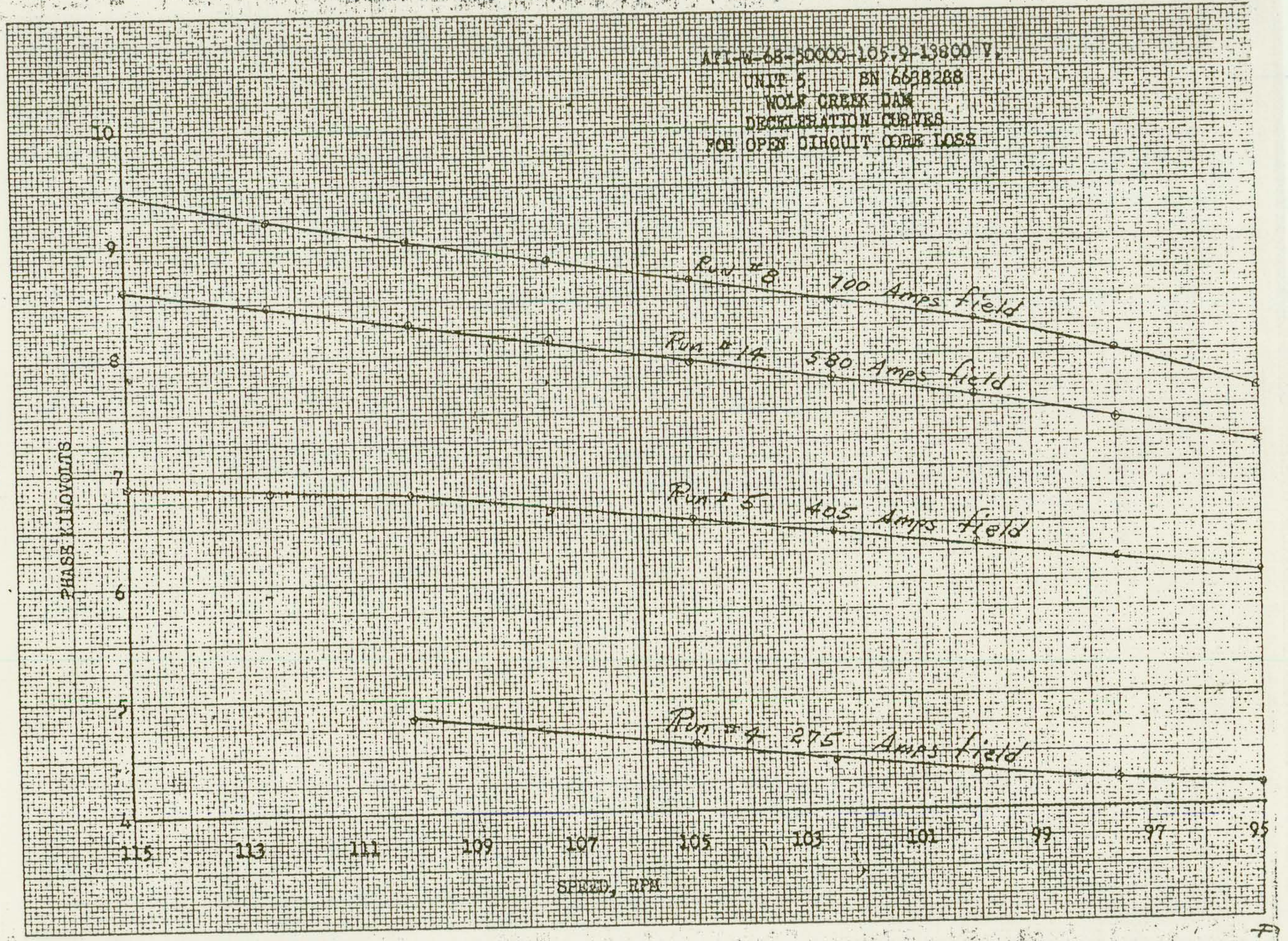
The open circuit core loss is obtained in Table 2 by subtracting from each calculated point a friction and windage loss of 342 KW.

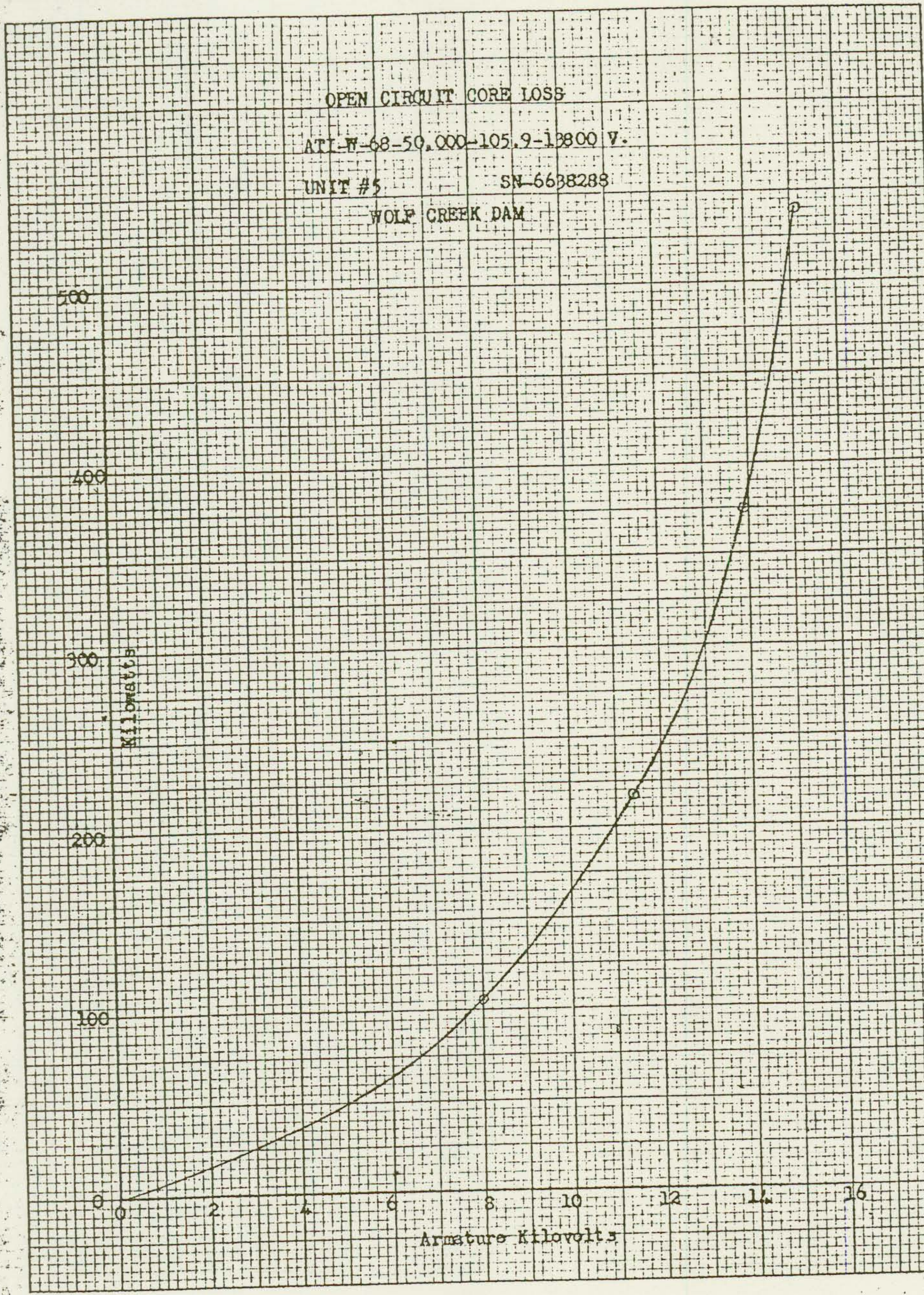
The short circuit core loss is obtained in Table 3 by subtracting the friction and windage loss and an I^2R loss corresponding with the measured current and corrected armature resistance for the run.

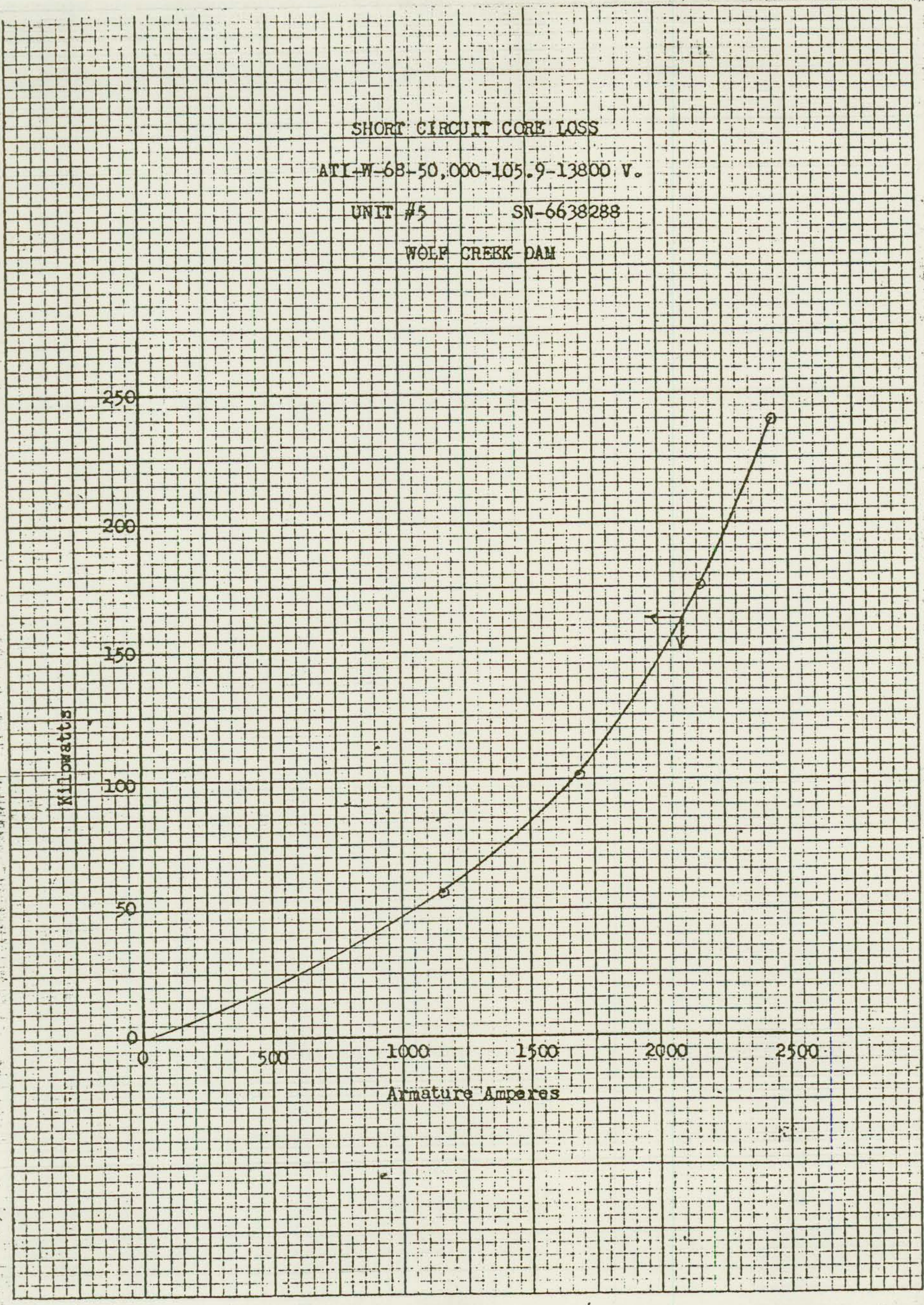
The data for Tables 2 & 3 are plotted on pages 12, 13 and 14.

GENERATOR FRICTION AND WINDAGE

As previously agreed upon, the value of friction and windage to be applied to the generator was in the proportion of the calculated generator friction and windage to the total calculated friction and windage.


ATI-W-68-50000-105.9-13800 V.
UNIT 5 SN 6638288
WOLF CREEK DAM
DECELERATION CURVES
FOR OPEN CIRCUIT CORE LOSS
PHASE KILOVOLTS
10
9
8
7
6
5
4
115
113
111
109
107
105
103
101
99
97
95
SPEED, RPM
Run #8 700 Amps field
Run #14 580 Amps field
Run #5 405 Amps field
Run #4 275 Amps field


OPEN CIRCUIT CORE LOSS
ATI-W-68-50,000-105.9-13800 V.
UNIT #5
SN-6638288
WOLF CREEK DAM
500
400
300
200
100
0
Kilowatts
0
2
4
6
8
10
12
14
16
Armature Kilovolts


SHORT CIRCUIT CORE LOSS
ATI-W-68-50,000-105.9-13800 V.
UNIT #5 SN-6638288
WOLF CREEK DAM
Kilowatts
250
200
150
100
50
0
0
500
1000
1500
2000
2500
Armature Amperes

The calculated generator friction and windage was 210 KW. The calculated turbine friction and windage was given as 171 KW. The calculated additional friction on the thrust bearing due to carrying the weight of the unwatered turbine during test was 6 KW. Therefore, the total calculated friction and windage was 387 KW. The portion assigned to the generator was 186 KW.

ARMATURE I^2R LOSS AT 75°C

The armature copper loss is the product of 3 x line to neutral d-c armature resistance at 75°C and the square of the armature line current. These values are tabulated in the Summary, Page 1.

FIELD I^2R LOSS AT 75°C

The field copper loss is the product of the field resistance at 75°C and the square of the field current at a given load. The field current for a specific load condition is calculated from the method outlined in paragraph 1.522, page 25 of the "A.I.E.E. Test Code for Synchronous Machines" dated June 1945. The Potier Reactance can be determined from the readings taken on the heat run by figuring from the method given in the reference, which is used in calculating the field current. This method gives a Potier reactance of 21.1% which was used in calculating field currents given below and as used in the I^2R field loss in the efficiency test.

Percent Load	Field Current Amperes		Field Loss Kilowatts	
	1.0 PF	0.9 PF	1.0 PF	0.9 PF
25	532	623	49.4	67.8
50	607	723	64.3	91.2
75	669	837	78.1	122.3
100	751	970	98.5	164
115	801	1054	112.	194

$R_{75°C} = .1745 = .1463\left(\frac{75+234.5}{25+234.5}\right)$

TELEPHONE INTERFERENCE FACTOR

Generator No. 5 was operated at rated speed and no load rated voltage. The voltage between each phase (stepped down through potential transformers) was in turn impressed on the terminals of a standard telephone interference factor meter. Balanced telephone interference factor is obtained from the expression:

$$TIF = I/_E$$

where I is the current in microamperes in the meter branch of a standard TIF meter and E is the voltage applied to the terminals of the TIF network. Readings were taken at 100% voltage on the generator terminals. The values obtained for TIF are as follows:

Phase A - B	9.65
B - C	9.69
C - A	9.69

The guaranteed maximum value of balanced telephone interference factor is 50.

WAVE FORM DEVIATION FACTOR

Generator No. 5 was operated at rated no load voltage and an oscillogram of the voltage wave shape of each phase was made. Reproductions of the three phase waves are included in this report. Values obtained are:

Phase	A – B	1.10%
	B – C	0.96%
	C – A	0.96%

DIRECT AND QUADRATURE SUBTRANSIENT REACTANCES

A new method of securing direct and quadrature values of subtransient reactances and negative sequence reactance, as described in "Electrical Engineering" for February 1952, was used. It consists of applying single phase power to each pair of line terminals of the generator in turn and measuring the line current and the applied voltage. The line current should be kept below 50% of rated current to prevent overheating the machine, which is at standstill. The field is short circuited for this test. From the three ratios of line voltage to line current the values of subtransient reactance, direct and quadrature, may be obtained from the formulae given in the above mentioned reference and listed here.

$$K = \frac{A + B + C}{3} \qquad M = \sqrt{(B-K)^2 + \frac{(C - A)^2}{3}}$$

where A, B and C are ratios of line volts to line amperes, taken in any order

K – constant offset or displacement component of the sine wave

M – Amplitude of the sine wave component

$X''_d = \frac{K - M}{2}$ ohms

$X''_q = \frac{K + M}{2}$ ohms

$X_2 = K/_2$ ohms

$$\frac{X''_q}{X''_d} = \frac{K + M}{K - M}$$

To obtain per unit values of reactance the above ohmic values were multiplied by the ratio of the rated stator amperes per phase to the rated stator phase volts.

Results obtained from the test results produce the following per unit quantities:

$X_d'' - 0.314$

$X_q'' - 0.388$

$X_2 - 0.350$

$\frac{X_q''}{X_d''} = 1.235$

NEGATIVE SEQUENCE REACTANCE

Generator No. 5 was connected so that a line-to-line short circuit was applied between phases B and C as illustrated on the wiring diagram on page 18. An ammeter was connected to a current transformer in phase C to read the current I as shown. A voltmeter was connected across the terminals of a potential transformer to read the voltage V from phase A to the short circuit as shown. A wattmeter was connected to read the product of the in-phase component of current and voltage. These meters were read for various values of field current and that results are plotted on page 18.

The per unit value of negative sequence reactance X_2 can be calculated from these readings by means of the formula given in paragraph 1.884, page 37 of the "A.I.E.E. Test Code for Synchronous Machines" dated June 1945

$$X_2 = \frac{W}{3\ I^2}$$

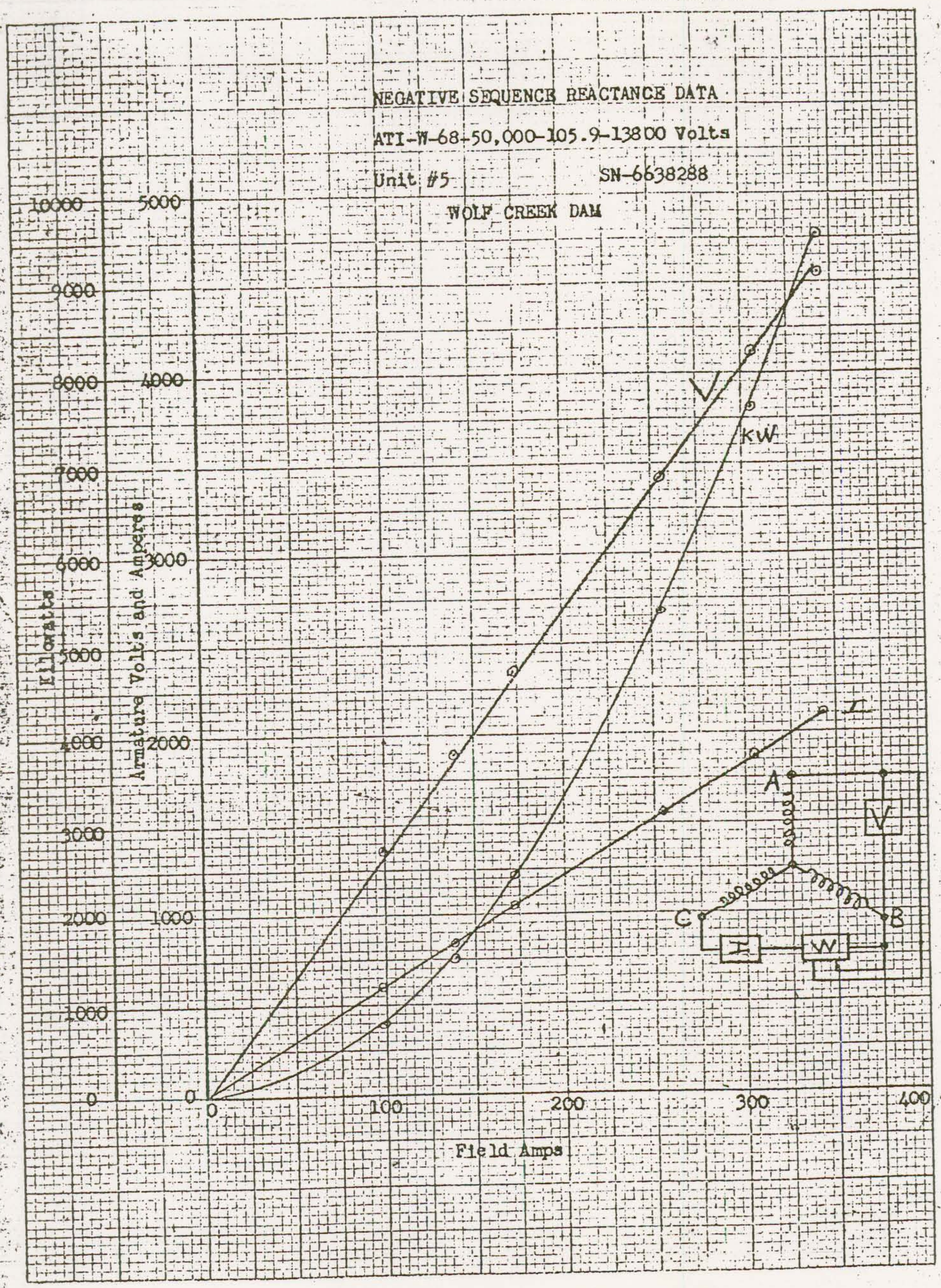
where W = wattmeter reading in per unit based on rated phase volt amperes
I = measured current in per unit based on rated phase current

Using this formula at rated armature current, a value of 0.330 per unit is obtained. As previously noted a value of 0.350 per unit is obtained from the test for direct and quadrature axis subtransient reactances. An average value of 0.34 per unit is used in the Summary.

A second method to determine the negative sequence reactance is given in paragraph 1.887, page 37 of the Test Code. This method uses the above data and the synchronous impedance curve on page 4. The value of X_2 is determined from the following relation:

$$X_2 = \frac{1}{I_{FG}} (\sqrt{3}\ I_{FSIS} - I_{FSI})$$

where I_{FG} = field current corresponding to rated voltage on the air gap line of the no load saturation curve.


NEGATIVE SEQUENCE REACTANCE DATA
ATI-W-68-50,000-105.9-13800 Volts
Unit #5
SN-6638288
WOLF CREEK DAM
Kilowatts
Armature Volts and Amperes
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5000
4000
3000
2000
1000
0
0
100
200
300
400
Field Amps
V
KW
I
A
B
C
V
I
W

I_{FSIS} = field current necessary to produce rated line current in a line-to-line short circuit saturation test.

I_{FSI} = field current necessary to produce rated line current on a three phase short circuit.

Using values of I_{FG}, I_{FSIS} and I_{FSI} from pages 4 and 18 the value of X_2 may be calculated from the above formula to be 0.301 per unit. Considering the previous values of X_2, this value seems too low to be considered.

ZERO SEQUENCE REACTANCE

Generator No. 5 was connected so that a line-to-line to neutral short circuit was applied between phase B and C. Current transformers and ammeters were arranged to read the line current and the neutral current. A potential transformer and voltmeter were connected to measure the voltage from line A to neutral, as shown in the wiring diagram on page 20.

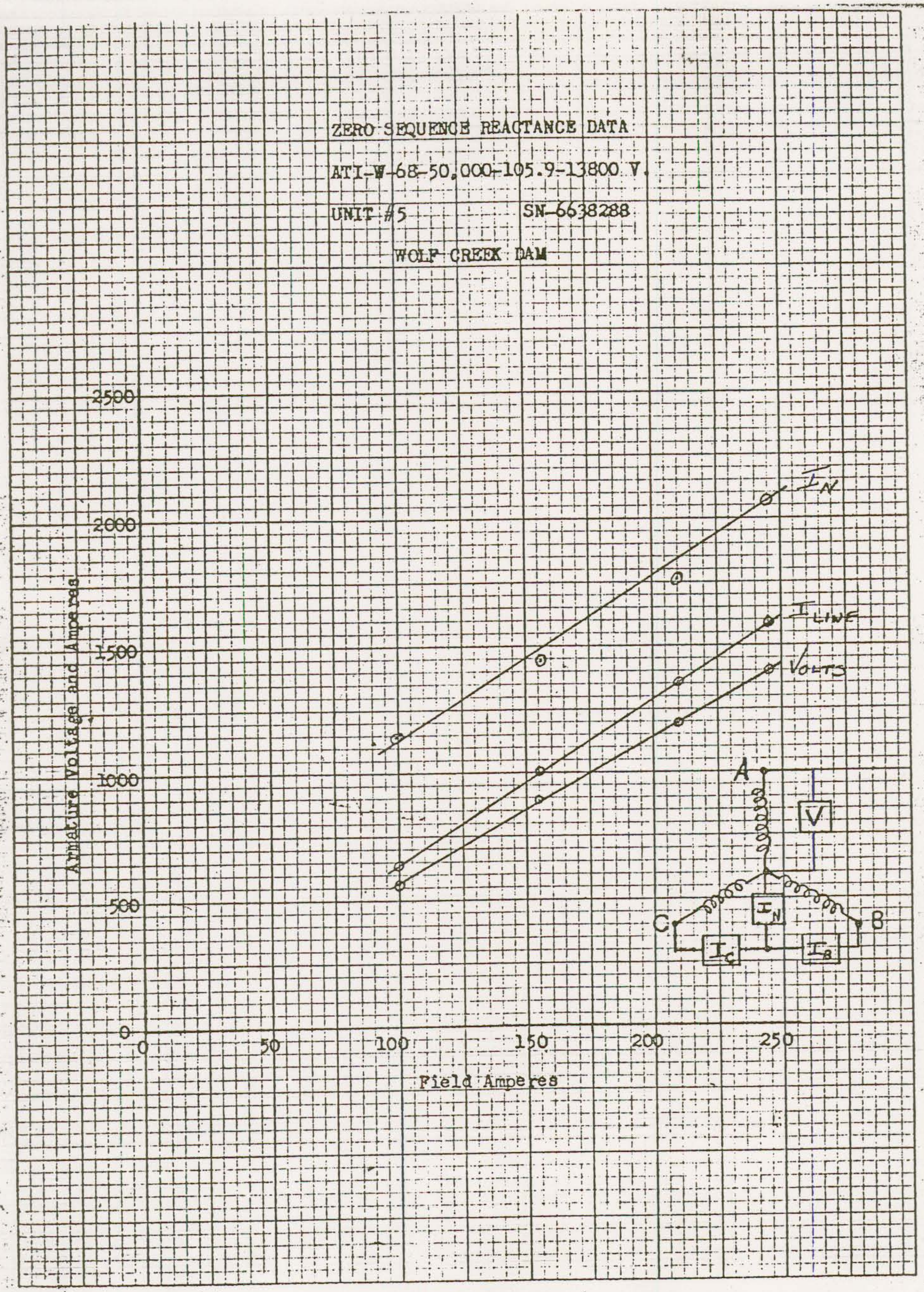
The zero sequence reactance X_o can be determined by means of the formula given in paragraph 1.894, page 38 of the A.I.E.E. Test Code previously mentioned

$$X_o = \frac{E_a}{I_N}$$

where E_a = per unit armature voltage based on rated phase volts

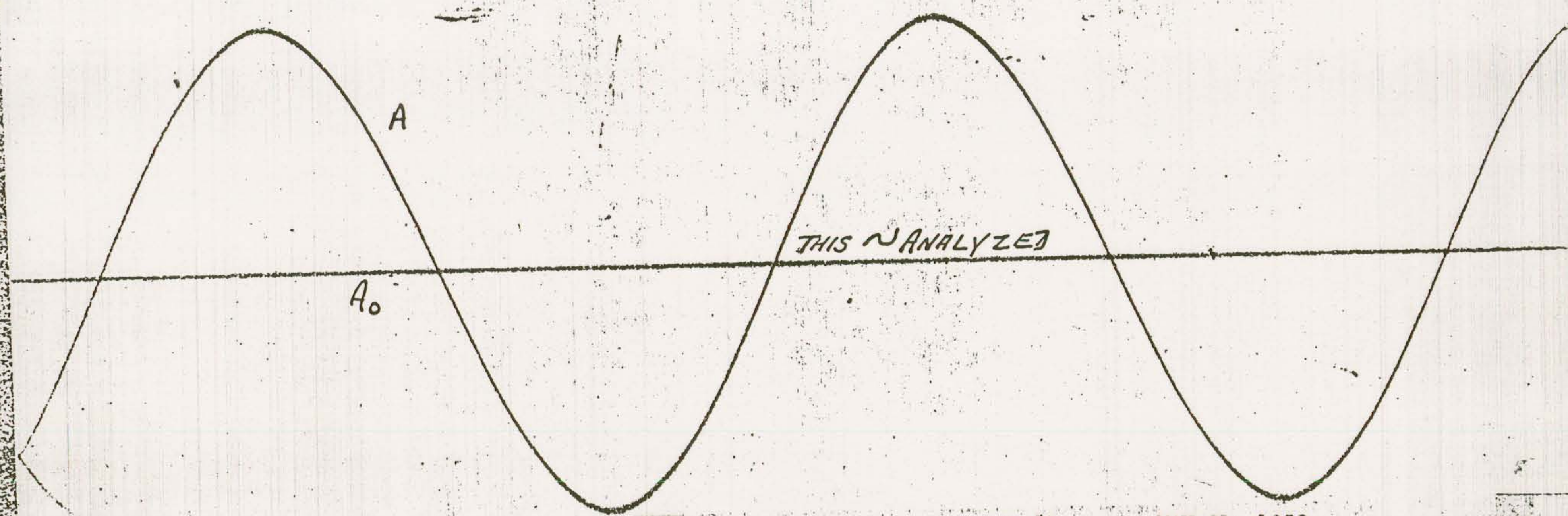
I_N = per unit neutral current based on rated phase current

The calculated value of X_o using the test results give the value of X_o of 17.7%.



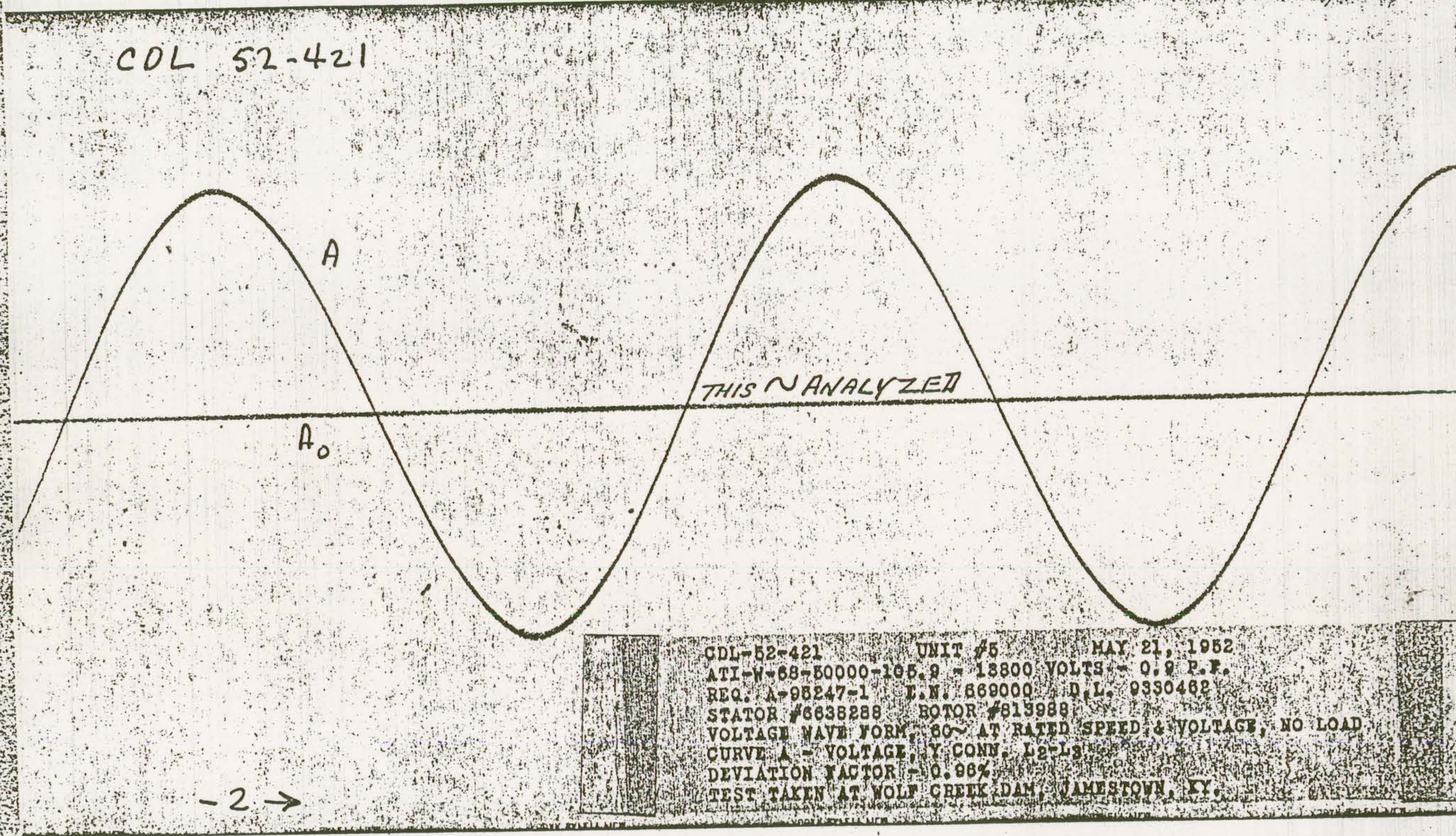
ZERO SEQUENCE REACTANCE DATA
ATI-W-68-50,000-105.9-13800 V.
UNIT #5
SN-6638288
WOLF CREEK DAM
Armature Voltage and Amperes
2500
2000
1500
1000
500
0
0
50
100
150
200
250
Field Amperes
I_N
I_{LINE}
VOLTS
A
B
C
V
I_N
I_C
I_B

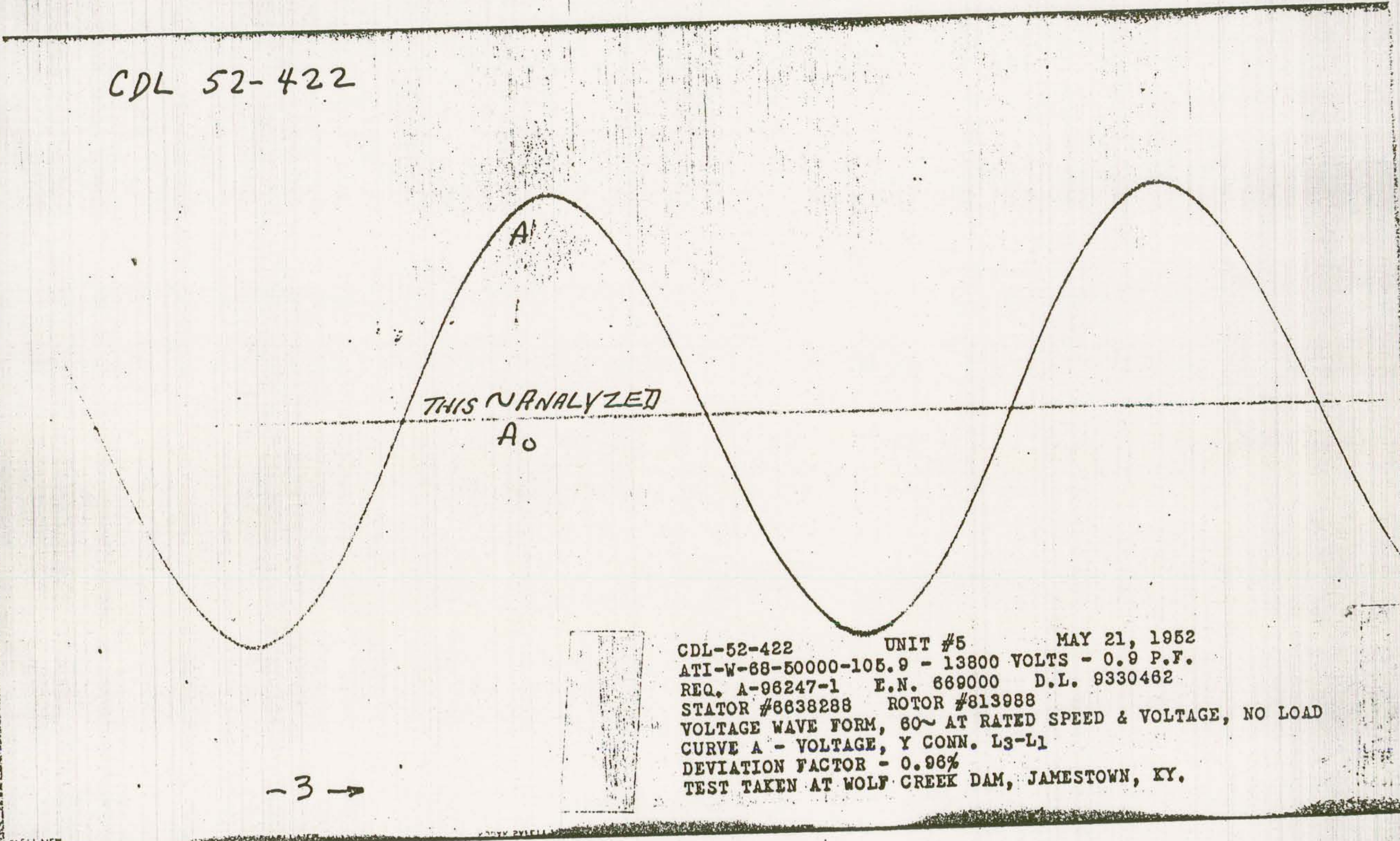
CDL 52-420



CDL-52-420 UNIT #5 MAY 21, 1952
ATI-W-68-50000-105.9 - 13800 VOLTS - 0.9 P.F.
REQ. A-96247-1 E.N. 669000 D.L. 9330462
STATOR #8638288 ROTOR #813988
VOLTAGE WAVE FORM, 60~ AT RATED SPEED & VOLTAGE, NO LOAD
CURVE A - VOLTAGE, Y CONN. L1-L2
DEVIATION FACTOR - 1.1%
TEST TAKEN AT WOLF CREEK DAM, JAMESTOWN, KY.

—1→


CDL 52-421
A
A_0
THIS ~ ANALYZED
CDL-52-421 UNIT #5 MAY 21, 1952
ATI-W-68-50000-105.9 - 13800 VOLTS - 0.9 P.F.
REQ. A-95247-1 I.N. 669000 D.L. 9330462
STATOR #6638288 ROTOR #813988
VOLTAGE WAVE FORM, 60~ AT RATED SPEED & VOLTAGE, NO LOAD
CURVE A - VOLTAGE, Y CONN. L2-L3
DEVIATION FACTOR - 0.96%
TEST TAKEN AT WOLF CREEK DAM, JAMESTOWN, KY.
-2 →



CDL-52-422 UNIT #5 MAY 21, 1952
ATI-W-68-50000-105.9 - 13800 VOLTS - 0.9 P.F.
REQ. A-96247-1 E.N. 669000 D.L. 9330462
STATOR #6638288 ROTOR #813988
VOLTAGE WAVE FORM, 60~ AT RATED SPEED & VOLTAGE, NO LOAD
CURVE A - VOLTAGE, Y CONN. L_3-L_1
DEVIATION FACTOR - 0.96%
TEST TAKEN AT WOLF CREEK DAM, JAMESTOWN, KY.